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Wulf Nagel

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EXAMINER

TRINH, THANH TRUC

ART UNIT

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1795

MAIL DATE

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/573,864	Applicant(s) NAGEL, WULF	
	Examiner THANH-TRUC TRINH	Art Unit 1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 12 September 2008.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-9 and 11-17 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-9 and 11-17 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>9/12/08</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Remark

1. Claims 1-9, 11-17 are pending in the application

Claim Objections

2. Claims 2 and 11 are objected to because of the following informalities:

Regarding claim 2, the phrase “the working element is substantially electrically insulated, namely neither connected to a positive nor to a negative pole of the photovoltaic element” should be changed to “the working element is substantially electrically isolated from a positive pole and a negative pole of the photovoltaic element.” A metal material cannot be electrically insulated.

Claim 11 depends on a canceled claim 10. Claim 11 is treated as though it depends on claim 1.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 1, 5 and 11-12 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Regarding claim 1, the phrase "an electrically conductive large-surface working element, made of metal" renders the claim indefinite as to unclear what is meant by "made of metal", e.g. as in consisting of metal or metals or as in comprising of metal or metals. It is treated as though it comprises metal or metals.

Claims 5 depends on claim 3 and recites the limitation "the at least one conductor comprises a plurality of conductors wherein at least one conductor is configured as a positive conductor and at least one conductor is configured as a negative conductor" in lines 2-4. The meets and bounds of the limitation cannot be determined. It is unclear as to one conductor (or a single conductor) cannot comprise "a plurality of conductors".

Claim 11 recites limitation "the 3.-6. main group" in line 2 and "the 1.-8. subgroup" in line 3. There are no antecedent bases for these limitations. The phrase "preferably" also renders the claim indefinite because it is unclear whether the limitations following the phrase are part of the claimed invention. See MPEP § 2173.05(d). It is also unclear what material is being claimed in the claim.

Regarding claim 12, the phrases "preferable" and "more preferred" render the claim indefinite because it is unclear whether the limitations following the phrase are part of the claimed invention. See MPEP § 2173.05(d)

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

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A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims 1-5, 8 and 11 are rejected under 35 U.S.C. 102(b) as being anticipated by Evans Jr. et al. (US Patent 4341918).

Regarding claims 1 and 11, as seen in Figure 1, Evans Jr. et al. teaches a photovoltaic element comprising a photon absorber (or p-type base layer 12) and an electrically conductive large-surface working element (or p+ field region 14) that is at least partly embedded in the photon absorber, wherein the working element is separated from the photon absorber by a phase boundary (or having a higher conductivity), and the working element having a greater electron mobility than the photon absorber by having a p+ doping comparing to a p doping of the photon absorber. (See col. 4 line 17 to col. 5 line 14). Evans Jr. et al. also the material used for the solar cell is made of IIIA-VA or IIB-VIA (See col. 4 lines 35-37), wherein IIIA, VIA and IIB are from 3.-6. main group and VIA from 1. – 8. subgroup. Metal materials such as Ga, In Zn, Cd are metals having electron configuration of ten electrons in d-layer.

Regarding claim 2, as seen in Figure 1, Evans Jr. et al. teaches the working element (or p+ field region 14) does not connected to any conductive electrode. Therefore it is the Examiner's position that the working element (or p+ field region 14) is substantially electrically insulated from the positive and negative pole of the photovoltaic element.

Regarding claim 3, as seen in Figure 1, Evans Jr. et al. teaches at least one conductor (p+ base 20) is at least partly embedded in the photon absorber and has the same composition as the working element.

Regarding claim 4, as seen in Figure 1, Evans Jr. et al. teaches the working element (14) and the conductors (20 or 22) are elongate and substantially parallel to each other.

Regarding claim 5, as seen in Figure 1, Evans Jr. et al. teaches the conductors (20 or 22) are configured as a positive conductor (20) and a negative conductor (22), wherein the positive conductor (20) ends at a first front side of the photon absorber (either the side facing downward or "out of page" or "into the page" as seen in Figure 1) and the negative conductor ends at a second front side of the photon absorber (either the side "out of page", "into the page" or facing downward as seen in Figure 1).

Regarding claim 8, Evans Jr. et al. teaches the photon absorber (or p-type base 12) is made of silicon wafer (See col. 4 lines 17-38 or col. 7 lines 10-15).

5. Claims 1-2 and 11-12 are rejected under 35 U.S.C. 102(b) as being anticipated by Forrest et al. (US Patent 6657378).

Regarding claims 1-2, as seen in Figure 1, Forrest et al. teaches a photovoltaic element comprising a photon absorber (including layers BCP, PTCBIs, CuPcs); an electrically conductive large-surface working element made of metal (Ag) embed in the middle of the absorber, wherein the working element being separated from the photon absorber by a phase boundary (i.e. different materials), and the working element having

a greater electron mobility than the photon absorber because it is made of metal material such as Ag. The Ag layer of Forrest et al. is isolated from the positive and negative poles of the photovoltaic element (such as Ag and ITO electrodes).

Regarding claims 11-12, since the working element of Forrest et al. made of metal such as silver, therefore the working element is a subgroup metal from the 1.-8. subgroup with an electron configuration of d-layer occupied by ten electrons, and has an electric conductivity higher than $1.4 \Omega^{-1}\text{cm}^{-1}$, or $1.6 \Omega^{-1}\text{cm}^{-1}$ or $2.0 \Omega^{-1}\text{cm}^{-1}$

6. Claims 1-2 and 11-12 are rejected under 35 U.S.C. 102(b) as being anticipated by Mauk (US Patent 5828088).

Regarding claim 1, as seen in Figures 1-3, Mauk teaches a photovoltaic element comprising a photon absorber (including layers GaAs substrate, epitaxial layers p-type cladding layer, p-type base, n-type emitter); an electrically conductive large-surface working element (buried mirrors or reflective mask) made of refractory metals such as tungsten (See col. 7 line 60 through col. 8 line 67), wherein the working element is separated from the photon absorber by a phase boundary (i.e. different material) and has a greater electron mobility than the photon absorber.

Regarding claim 2, as seen in Figures 1-3, the working element (buried mirrors or reflective mask layers) is substantially electrical isolated from the positive and negative poles (back contact and emitter contact) of the photovoltaic element.

Regarding claims 11-12, metal such as tungsten is from the 3.-6. main group and has electron configuration of d-layer occupied by ten electrons. The conductivity of

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tungsten is $176.991 \times 10^3 \Omega^{-1}\text{cm}^{-1}$ (See Tungsten element facts provided by Chemicool.com) which is inherently higher than $1.4 \Omega^{-1}\text{cm}^{-1}$, or $1.6 \Omega^{-1}\text{cm}^{-1}$ or $2.0 \Omega^{-1}\text{cm}^{-1}$.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
 2. Ascertaining the differences between the prior art and the claims at issue.
 3. Resolving the level of ordinary skill in the pertinent art.
 4. Considering objective evidence present in the application indicating obviousness or nonobviousness.
7. Claims 6-7, 9 and 13-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Evans Jr. et al. in view of Warner (US Patent 3994012)

Evans Jr. et al. teaches a photovoltaic element as applied to claims 1-5, 8 and 10-11.

Evans Jr. et al. does not teach two photon absorbers are in contact via an abutment surface in which the positive conductors are separated from the negative conductors by the abutment surface; or a plurality of positive conductors are connected with each other through an omnibus and a plurality of negative conductors are

connected with each other via a second omnibus conductor; or a plurality of photovoltaic elements arranged in a recess wherein the recess is in contact with at least one photon absorber; or two photon absorbers have a mutually anti-parallel crystal structure.

With respect to claims 6-7, as seen in Figures 15-20 and 32-33, Warner teaches a photovoltaic element having a multi-layer structure, wherein at least two absorbers (right and left columns of multilayers of N and P) are provided in contact via an abutment surface (or the bottom surface of interconnection 45 as seen in Figures 15-20) in which the positive conductors (P+ regions next to the interconnection 45) and the negative conductors (N+ regions next to the interconnection 45) are arranged such that the positive conductors and the negative conductors are separated from each other by the abutment surface, and the plurality of positive conductors are connected with each other through a first omnibus conductor (or interconnection 45 via comb-like extension 62) and a plurality of negative conductors are connected with each other via a second omnibus conductor(or interconnection 45 via comb-like extension 60).

With respect to claim 9, Warner teaches connecting a plurality of single crystalline semiconductors of photovoltaic cells by series/parallel connection (See Abstract, col. 16 lines 55-68). In such connection of single crystalline photovoltaic cells, the two photon absorbers obviously have mutual anti-parallel crystal structure.

With respect to claims 13-16, as seen in Figures 15-20 and 27-33, Warner teaches a photovoltaic device comprising a receiving element (substrate 40 as seen in Figures 27-33) with recesses in which at least one photovoltaic element (columns of P

and N layers) is arranged, wherein conductors (P+ and N+ regions) present in the photovoltaic element are each connected to omnibus conductors (or interconnection 45 as seen in Figures 15-20). Warner also teaches a plurality of photovoltaic elements (absorbers layer of P material and conductors P+ and N+) are arranged in at least one recess, wherein the recess is in contact with at least one photovoltaic element (See Figures 27-33). Warner further teaches a connecting means (interconnection 45) for mechanically and electrically connecting at least two photovoltaic devices arranged side by side, wherein a plurality of first connecting conductors (i.e. comb-like extension 62) and a plurality of second connecting connectors (comb-like extension 60) are each connected with first current conductor (an interconnection 45 as seen in Figure 19) and second current conductor (another interconnection 45 as seen in Figure 19).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the photovoltaic element (or device) of Evans Jr. et al. by having absorbers in contact via an abutment surface, absorbers in recesses and mechanical and electrical connection as taught by Warner, because Warner teaches a photovoltaic cell including all the limitations disclosed by Warner and recited above would increase cell efficiency. (See Abstract of Warner). It would also have been obvious to connect single crystalline photovoltaic cells in series/parallel as taught by Warner to achieve a mutually anti-parallel crystal structure, because Warner teaches such connection is suitable configuration. (See col. 16 lines 55-68).

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8. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Evans Jr. et al.

Evans Jr. et al. teaches a photovoltaic element as applied to claims 1-5, 8 and 10-11. Evans Jr. et al. also teaches the device (or p-type crystal) operates in the range of resistivity of 0.01 ohm-cm and 30000 ohm-cm (See col. 4 lines 16-37), or the conductivity of $(1/3) \times 10^{-4}$ to $100 \Omega^{-1}\text{cm}^{-1}$. Note: the conductivity is the inverse of the resistivity. Evans Jr. et al. further teaches the working element (or p+ field region 14) has a p+ conductivity, or a higher conductivity than the p-type crystal. Therefore it would have been obvious to one skilled in the art that the time the invention was made that the working element (or p+ field region 14) of Evans Jr. et al. has an electric conductivity higher than $1.4 \Omega^{-1}\text{cm}^{-1}$, or $1.6 \Omega^{-1}\text{cm}^{-1}$ or $2.0 \Omega^{-1}\text{cm}^{-1}$, because Evans Jr. et al. teaches the conductivity of p-type crystal (a lesser conductivity compared to the p+) is up to $100 \Omega^{-1}\text{cm}^{-1}$. In addition, it would certainly have been obvious to one skilled in the art to select a portion of range, including the claimed range, from a broader range disclosed in the prior art because the prior reference finds that the entire disclosed range has a suitable utility.

9. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Evans Jr. et al. in view of in view of Lidorenko et al. (US Patent 4174978)

Evans Jr. et al. teaches a photovoltaic element as applied to claims 1-5, 8 and 11 above.

Evans Jr. et al. does not teaches using two respective photon absorber having an anisotropic monocrystalline silicon.

Lidorenko et al. teaches using monocrystalline silicon (or silicon wafer, plate) having surfaces oriented along <100> (See col. 10 lines 45-56). It is the Examiner's position that <100> silicon wafer or plate is an anisotropic monocrystalline silicon.

It would have been obvious to one skilled in the art at the time the invention was made to modify the photovoltaic element of Evans Jr. et al. by using anisotropic monocrystalline silicon as taught by Lidorenko et al., because Lidorenko et al. finds it is suitable material in solar cell (See col. 10 lines 45-56), and Evans et al. also suggests using silicon.

Response to Arguments

Applicant's arguments filed 9/12/2008 have been fully considered but they are not persuasive.

Applicant argues that GaAs or CdS are not metals, but are semiconductors. However, the Examiner respectfully disagrees. First of all, claim 1 recites the limitation "an electrically conductive large-surface working element made of metal" in line 3. The phrase "made of metal" is unclear as if it is an open-type transitional phrase like "comprising of metal or metals" or a close-type transitional phrase like "consisting of metal or metals. The claims are treated as an open-type. However, Evans Jr. not only teaches GaAs, but also IIIA-VA semiconductors (See col. 4 lines 36-37); wherein all IIIA materials are metal, and VA materials such as Sb and Bi are material. Therefore a

semiconductor such as InSb is practically made of metals. In addition, GaAs is the combination of Ga and As, wherein Ga (gallium) and As (arsenic) are sometimes known to be metal (See Jensen, US Patent 4594264, Background of the Invention, especially col. 2 lines 1-7).

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to THANH-TRUC TRINH whose telephone number is (571)272-6594. The examiner can normally be reached on 8:30 am - 5:00 pm.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on 571-272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Nam X Nguyen/
Supervisory Patent Examiner, Art Unit 1753

TT
12/22/2008